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Invention: TRANSMISSION METHOD AND RADIO SYSTEM

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SPECIFICATION

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TRANSMISSION METHOD AND RADIO SYSTEM

FIELD OF THE INVENTION

The invention relates to a transmission method used in a radio system comprising a base transceiver station acting as a transceiver and subscriber terminals acting as transceivers which are connected to each other by means of a signal propagating through the base transceiver station, which signal contains speech or data which is coded before it is transmitted to the radio path and decoded when it is received from the radio path, and in which method the signal establishing the connection is transmitted in a radio channel formed for each connection.

BACKGROUND OF THE INVENTION

In a cellular radio system, discontinuous transmission, or DTX, is used to reduce interference and the power consumption of a subscriber terminal. The cellular radio system can be a GSM system, for instance. When a speech coder of a transceiver notices a break in speech, the transceiver only transmits a silence descriptor frame, i.e. SID frame. A SID frame is typically transmitted once every 480 ms.

A SID frame is typically used to generate noise in a subscriber terminal in DTX mode. If a noise of suitable volume was not generated, the receiver would find the silence caused by breaks uncomfortable. In the worst case, the receiver would think that the connection has been broken. During breaks in speech, the coder enters DTX mode during which SID frames are transmitted. The SID frames transmitted during breaks in speech comprise various update data. The receiver uses the update data when generating noise, for instance. In addition, L2 filler frames, for instance, are transmitted during DTX. Filler frames are transmitted when there is nothing else to transmit.

A transceiver of a radio system can in some cases very quickly need information on the changes taking place in the radio channel. This means that the subscriber terminal must receive updated information on the status of the data and radio channel at a fast pace. A receiver of the kind mentioned above is for instance an AMR transceiver (AMR = Adaptive Multirate) which requires a fast adaptation rate. In addition, radio systems need to transmit control commands, for instance, as often as possible to a coder and decoder concerning the AMR mode, for instance. However, during

DTX, it is not possible to increase the channel update rate, i.e. the number of transmitted frames, enough without reducing too much the benefit derived from DTX.

BRIEF DESCRIPTION OF THE INVENTION

It is thus an object of the invention to implement a transmission method and a radio system so as to solve the above-mentioned problems. This is achieved by the type of transmission method disclosed in the preamble, characterized by measuring the radio channel and transmitting a control signal on the basis of the obtained measurement results from a transceiver in DTX mode to a transceiver with which the transceiver in DTX mode has formed the radio channel, and transmitting the control signal at a power level which is lower than the power level used in transmitting speech or data signals, and updating with the received control signals the operating parameters of the transceiver forming the radio channel to the transceiver in DTX mode.

A further object of the invention is a radio system comprising a base transceiver station acting as a transceiver and at least two subscriber terminals acting as transceivers which are connected to each other by means of a signal propagating through the base transceiver station, which signal contains speech or data; a transceiver in the radio system comprises a coder, which codes the signal to be transmitted to the radio path, and a decoder, which decodes the signal received by the transceiver, which has propagated in the radio path in the radio channel formed for the connection between the subscriber terminal and the base transceiver station.

The radio system of the invention is characterized in that it comprises measuring means which measure the status of the radio channel formed between the base transceiver station and the subscriber terminal, transmission means which transmit a control signal on the basis of the measurement results of the measuring means from the transceiver in DTX mode to the transceiver with which the transceiver in DTX mode has formed a radio channel, and which transmission means transmit the control signal at a power level which is lower than the power level used for transmitting speech or data signals, and control means which update operating parameters with the received control signals from the transceiver which is connected to the transceiver in DTX mode by means of the radio channel.

The preferred embodiments of the invention are set forth in the dependent claims.

The invention is based on the idea that the transceiver in DTX mode transmits a control signal using a lower transmission power level than used in transmitting a normal signal containing speech or data.

The transmission method and radio system of the invention provides several advantages. The transceiver in DTX mode transmits at a relatively low transmission power level control signals which alter the operating parameters of the transceiver receiving the control signals, whereby the adaptation of the transceiver receiving the control signals to the speech or data signals can be accelerated. In addition, it is possible to transmit, at a lower transmission power level than that used in transmitting normal speech and data signals, to the transceiver in DTX mode a control signal, with which the coding and decoding rates of the signal are altered. This way, the coding rates used by the base transceiver station and the subscriber terminal in speech and data coding and decoding remain optimal all the time. The method of the invention is particularly well suited for radio systems based on a very fast transmission frequency whereby a high transmission capacity can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in greater detail in connection with preferred embodiments and with reference to the attached drawings in which

Figure 1 shows a radio system which uses the method of the invention,

Figure 2 shows the structure of a transceiver used in a radio system of the invention in principle,

Figure 3 shows a signal transmitted by a transceiver in a radio system of the invention,

Figure 4 shows a signal transmitted by a transceiver in a radio system of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a cellular radio system which uses the method of the invention. The presented cellular radio system comprises a base station controller 300, base transceiver stations 200 and a set of subscriber terminals

100, 101. The base transceiver stations 200 and subscriber terminals act as transceivers in the cellular radio system. The subscriber terminals establish a connection to each other by means of signals propagated through the base transceiver station 200. A subscriber terminal 100 can be a mobile phone, for instance. The radio system presented in Figure 1 can be a GSM or CDMA system, for instance.

Figure 2 shows the structure of a transceiver used in a radio system of the invention in principle. The transceiver presented in Figure 2 can either be a subscriber terminal 100 or a base transceiver station 200. The transceiver comprises an antenna 150 which in practice functions as a transceiver antenna. Additionally, the transceiver comprises radio frequency parts 112, 124, a modulator 123, a demodulator 113 and a control block 120. The radio frequency parts 112 function in practice as signal reception means. The radio frequency parts 124 function in practice as signal transmission means.

Further, the transceiver comprises a coder 122 and a decoder 114. The radio frequency parts 112 transmit the radio frequency signal coming from the antenna to an intermediate frequency. The intermediate frequency signal is forwarded to the demodulator 113 which demodulates the signal. After this, the demodulated signal is decoded in the decoder 114. The decoder for instance decrypts and channel-decodes the signal. The task of the control block 120 of the transceiver is to control the functions of the above-mentioned transceiver blocks.

Coder 122 receives the signal and transmits the signal it has coded to the modulator 123. The coder 122 uses convolution coding, for instance, in the coding. In addition, the coder 122 for instance encrypts and channel-codes the signal. Further, the coder 122 interleaves the bits or bit groups in the signal. After this, the convolution-coded signal is forwarded to the modulator 123 which modulates the signal. After this, the signal is forwarded to the transmission means 124 which convert the modulated signal into radio frequency format. The transmission means transmit the modulated signal by means of the antenna to the radio path.

Let us assume that, for optimum operation, the coder 122 and decoder 114 residing in the transceiver of the radio system very quickly need information on the changes occurring in the radio channel. In the above situation, the information on the status of the radio channel must be updated

at a fast pace. The transceiver comprises measuring means 115 measuring the radio channel, and the measurement data obtained from them is forwarded on to the coder and decoder. For instance, an AMR transceiver (AMR = Adaptive Multirate) comprises a coder 122 and decoder 114 which require a fast adaptation rate. In practice, a fast adaptation rate means that the coder 122 and decoder 114 occasionally very quickly need information on the changes occurred in the radio channel. If the radio channel weakens quickly, information on the weakening must be transmitted as quickly as possible from the transceiver receiving the signal to the transceiver transmitting the signal.

The transceiver in DTX mode measures the radio channel from the filler frames it has received. On the basis of the frames measured by the measuring means 115, the transmission means 124 transmit a control signal which contains information on the status of the radio channel in the down link direction. The radio channel status information can for instance be based on the level, power, signal-to-noise ratio or bit error ratio of the received signal. The operating parameters of the transceiver in DTX mode are updated by means of the status information. Updating the operating parameters affects the operation of the transceiver. The control signal can contain information on handover, for instance, which means that receiving the control signal can alter the operation of the transceiver in a handover situation. The subscriber terminal 100, 101 can transmit control signals to the base transceiver station 200. In addition, the base transceiver station can transmit control signals to the subscriber terminal.

If the operating parameters are coding parameters, the transceiver can receive from the transceiver in DTX mode a control signal by means of which the transceiver can update the coding parameters of its coder and decoder. In practice, the coder and decoder alter their adaptation rate on the basis of the control signals. The coder 122 and decoder 114 can alter their coding rate so that when the coding rate of the speech coder increases, the coding rate of the channel coder decreases. In practice, the coder 122 and decoder 114 have a set of predefined standard coding rates which are, when necessary, altered according to the control data in the received control signals.

The control means 120 can update the coding parameters of the coder 122 acting as a speech coder, which alters the coding rate of speech. The decoding rate used by the decoder 114 can be updated in the same way. Further, the coding parameters of the coder acting as a channel coder can be

updated, which alters the channel coding rate of the channel coder. The decoding rate of the channel decoder can also be altered by means of control signals received by the transceiver.

The coding rates of a coder 122 and a decoder 114 acting as a speech coder can typically vary from 4.5 to 13 kbit/s. The coding rate of a coder acting as a channel coder can typically vary from 9 to 17.5 kbit/s, when the channel coder operates at full speed. The speed of a signal coded by a channel coder is between 0 to 6.5 kbit/s, when the channel coder operates at half speed. On the basis of the measurement result obtained from measuring the radio channel, it is possible to transmit a control signal which alters the coding parameters of the speech coder and channel coder.

Before receiving a control signal, the speech coder can have coded at a rate of 4.5 kbit/s, for instance, and the channel coder can have coded at a rate of 17.5 kbit/s, for instance. After the update of the coding parameters, the speech coder can code at a rate of 13 kbit/s, for instance, and the channel coder at a rate of 9 kbit/s, for instance. Due to updates during DTX, a coder and decoder can adapt faster to the signal being coded or decoded, because the coder and decoder can be set in a predefined optimum operation mode. An increase in the speech coding rate decreases the channel coding rate, and an increase in the channel coding rate decreases the speech coding rate.

Figure 3 shows a signal, which is in an SACCH frame structure, transmitted by a transceiver in a radio system. Figure 3 shows that the transceiver, for instance a base transceiver station, transmits to another transceiver, for instance a mobile phone, speech frames 10 in an SACCH frame. In addition, the transceiver occasionally transmits SID frames and L2 filler frames 30 to the radio path. Information required for measuring the radio channel is transmitted in the SID frames and L2 filler frames 30. During DTX, the transmission means 124 of the transceiver of the invention transmit the SID frames and L2 filler frames at the same power level as the speech frames 10. If the SID frames and L2 frames were transmitted at a lower power level, problems would arise in measuring the radio channel, because a signal with a lower power is more sensitive to various interfering signals.

During DTX, the transmission means 124, which are radio frequency parts in practice, transmit update frames at a lower transmission power level than speech frames. Figure 3 shows that the transmission means 124 transmit update frames in a continuous manner when normal speech

frames 10 or filler frames 30 are not transmitted. In other words, in a situation according to Figure 3, update frames 20 are uninterruptedly transmitted when speech frames or frames used for measuring the channel are not transmitted.

Because the transmission power of the transceiver is, at least to some extent, on all the time, the radio channel can be uninterruptedly estimated. The transmission power of the update frames 20 can for instance be half of that of a speech frame or of frames used for measuring. Even though the update frames are during DTX transmitted at a lower transmission power than speech frames during normal transmission, the average transmission power during DTX increases slightly.

Figure 4 also shows a signal, which is in an SACCH frame structure, transmitted by a transceiver in a radio system. In this case, too, the transmission means 124 of the transceiver transmit the SID frames and L2 filler frames with the same power as the speech frames during DTX. However, Figure 4 shows clearly that the transmission means 124 do not transmit update frames in a continuous manner when normal speech frames 10 or filler frames 30 are not transmitted, but the transmission of the update frames 20 is periodic. In this case, too, the transmission power of the update frames can for instance be only half of the transmission power of a speech frame or of frames used for measuring.

In the situation shown in Figure 4, the update frames 30 are transmitted three separate times between two SID frames. The transmission frequency of the update frames can, however, be lower or higher than described above. The update frames are transmitted during DTX at a lower transmission power than normal speech frames. Even periodic transmission of update frames increases the average transmission power during DTX somewhat as compared with a situation where no update frames are transmitted during DTX.

Because the transceiver is on during DTX, control commands related to the AMR mode, for instance, can be transmitted to the coder and decoder. The control commands can be transmitted in the same way as the update frames. This means that the control commands can be transmitted periodically or as a continuous transmission during DTX. Since information on the status of the radio channel is received during DTX, the power consumption of the subscriber terminal, for instance, can be reduced.

If, during DTX, update data and control commands are transmitted with a considerably lower transmission power, the coder 122 must use efficient channel coding to avoid possible problems arising from the use of the lower transmission power. Turbo coding, for instance, can be used in channel coding to compensate for the increase in errors. By using efficient channel coding, the errors detected in a signal can be corrected in the decoder 114, for instance. Instead of turbo coding, for instance convolution coding can be used, in which the coding depth is greater than in a normal situation.

Even though the invention has been explained in the above with reference to examples in accordance with the accompanying drawings, it is obvious that the invention is not restricted to them but can be modified in many ways within the scope of the inventive idea disclosed in the attached claims.